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Abstract

THE NRTS ADVANCED TEST REACTOR

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The Advanced Test Reactor, located at the National Reactor Testing Station in Idaho, was designed to provide large-volume engineering test facilities at perturbed thermal-neutron flux levels greater than 10^{15} nv. Forty curved-plate aluminum/uranium fuel elements provide nine spaces each capable of accommodating an experimental loop. Properties resulting from the novel design include: 1) negligible variation in neutron flux with time, 2) small and constant spatial flux gradients, 3) spectral adjustment for each experiment, 4) independently adjustable flux levels in five of the test positions, and 5) negligible interaction between experiments.

The four-foot-long active core is arranged to provide six-inch-diameter test spaces that are nearly optimum for experiments with cylindrical symmetry. The loops may penetrate both the top and bottom reactor vessel closures as well as nozzles penetrating the side wall, thereby providing for a variety of loop designs. Control drives are disposed so as to cause a very small degree of mechanical interference with the loops.

The first complement of experiments was integrated into the reactor design using the experience gained during the many years of operation of loops in the Materials Testing Reactor and Engineering Test Reactor. Table I summarizes the principal final design characteristics of the ATR.

The shutdown control elements consist of safety rods, the hafnium sections of which are fully withdrawn from the core during operation, and hence do not introduce flux distortions. The operational control elements in the interior and outer reflector regions extend the full length of the core, thereby maintaining a symmetrical vertical flux pattern about the midplane, with an axial maximum-to-average value less than 1.4 throughout the entire seventeen-day

operating cycle. The control elements in the inner and outer regions can be varied independently to produce power shifting and hence accomplish experimental-flux control.

The reactor building provides an operating area of great experimental flexibility and convenience. The arrangement of the reactor, fuel-handling canal and experimental cubicles provides generous space allotments to both experiment and reactor operating functions. Ordinary utilities such as cooling water, electrical power, air, and hot and warm waste systems are available in sufficient capacity so that all common needs can be supplied to the loop facilities.

A Critical Facility, which is a nuclear duplicate of the ATR, is incorporated in a portion of the canal for experiment design, fuel loading, and physics studies applicable to the main reactor.

TABLE I

FINAL DESIGN CHARACTERISTICS OF THE ATR

Power level (megawatts)	250
Fuel region volume (liters)	262
Length of active core (feet)	4
Fuel loading (kilograms U-235)	35
Maximum power density (megawatts per liter)	2.8
Primary cooling water (U.S. gallons per minute)	47 000 - 53 000
Velocity in fuel element channels (feet per second)	44 - 46
Inlet temperature (degree Fahrenheit)	130
Core inlet pressure (pounds per square inch guage)	355
Core pressure drop (pounds per square inch)	100
Maximum thermal flux in experiments (perturbed)	1.5×10^{15}
Maximum fast flux (greater than 0.6 electron volts) in experiments	2.0×10^{15}